"Star Wars" Technology May Solve Down-to-Earth Insect Problem

Research is often like the rising tide that lifts all boats: One scientist's discoveries sometimes help colleagues in a completely unrelated field. That's how ARS entomologist Guy J. Hallman found himself controlling insects with electrical pulses.

At ARS' Crop Quality and Fruit Insect Research Unit in Weslaco, Texas, Hallman studies ways to prevent insect pests from hitchhiking on exported citrus. New methods for certifying U.S. citrus as pest free are needed before a U.S. Environmental Protection Agency ban on the fumigant methyl bromide takes effect in 2005.

Methyl bromide is currently the workhorse of fumigants used on a variety of crops in postharvest processing. But its days are numbered because it may deplete the Earth's ozone layer.

While scanning the scientific literature one day, a technical report by Q. Howard Zhang grabbed Hallman's attention. Zhang, a food processing engineer at Ohio State University, had used pulsed electric fields (PEF) to inactivate microbes such as *Escherichia coli* in food. "I imagined PEF technology might also kill fruit fly eggs and larvae in citrus," Hallman said.

PEF releases microsecond bursts of high-voltage electrical current. Unlike continuous current, PEF generates only a tiny amount of heat. Applied to certain foods, the process, called cold pasteurization, avoids changes in color, flavor, texture, and nutrients that might occur with thermal pasteurization.

Zhang himself had earlier been given a boost by researchers in a completely unrelated field—space.

In a lucky find, the Ohio State researcher uncovered an electrical pulse generator while exploring outmoded equipment shelved by the National Aeronautic and Space Administration. Researchers working on the Strategic Defense ("Star Wars") Initiative had used the generator to test communications microwave tubes.

After reading Zhang's report, Hallman suspected that, since insects are more complex than bacteria, PEF could destroy citrus pests with less than the 25,000 volts needed to kill *E. coli*. Hallman contacted Zhang, and the two began collaborating on trials using PEF to control a dangerous citrus pest—the Mexican fruit fly.

The researchers exposed fly eggs to ten 50-microsecond pulses of about 9,000 volts. Each pulse lasted for only 1- 20,000th of a second, but that was enough—less than 3 percent of the eggs hatched. Of the few that hatched and became larvae, none survived to adulthood.

Larvae proved even more vulnerable to PEF. None treated with as little as 2,000 volts lived past the pupal stage to adulthood. "Judging from the larvae's inability to recover from general paralysis," Hallman says, "we think PEF is very damaging to their nervous systems."

Is PEF an immediate candidate to replace methyl bromide? Hallman says it's not.

"A great deal more research is needed before we use PEF as a quarantine treatment." To that end, ARS is seeking an industrial partner to explore the potential for treating citrus with PEF.

Equipment limitations have thus far prevented the researchers from assessing PEF's effect on fruit quality. Future studies must also determine the economic feasibility and efficacy of PEF before the procedure could be approved for citrus certification.

Still, Hallman says, "It's imperative we examine a host of novel approaches that may come from work completely unrelated to insect control. No single method will completely replace methyl bromide."—By **Ben Hardin,** ARS.

Guy J. Hallman is in the USDA-ARS Crop Quality and Fruit Insect Research Unit, 2301 S. International Blvd., Weslaco, TX 78596; phone (956) 565-2647, fax (956) 565-6652, e-mail hallman@pop.tamu.edu. ◆